United States Patent [19]

Henebry et al.

[11] **3,744,650**

[45] **July 10, 1973**

[54] **BOAT MOVER FOR SEMICONDUCTOR FUSION PROCESS**

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[22] Filed: **Oct. 26, 1971**

[21] Appl. No.: **192,051**

[52] **U.S. Cl.** **214/23,** 432/239, 432/259

[51] **Int. Cl.** **F27d 5/00**

[58] **Field of Search** 263/47, 48, 41, 42, 263/52, 6; 432/253, 231, 239, 259, 262

[56] **References Cited**

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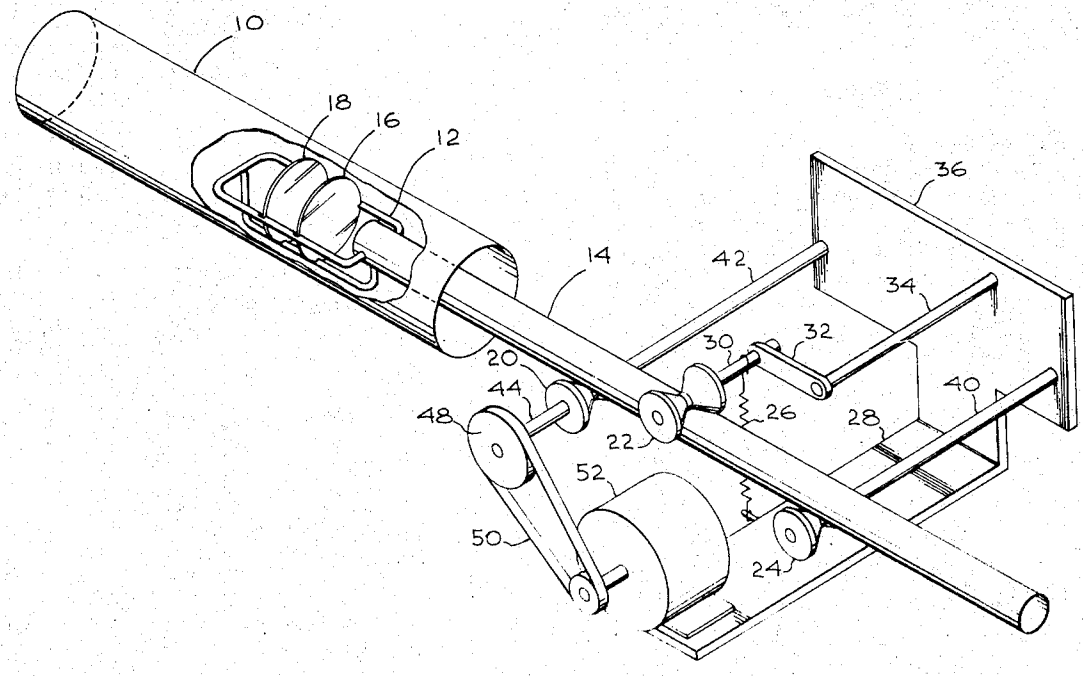
[57] **ABSTRACT**

An arrangement for moving a boat carrying semiconductor wafers through a diffusion furnace is provided wherein the boat is supported free of the walls of the furnace while being moved therethrough, whereby damage to the wafers caused by sudden stops and starts of the boat is avoided.

5 Claims, 1 Drawing Figure



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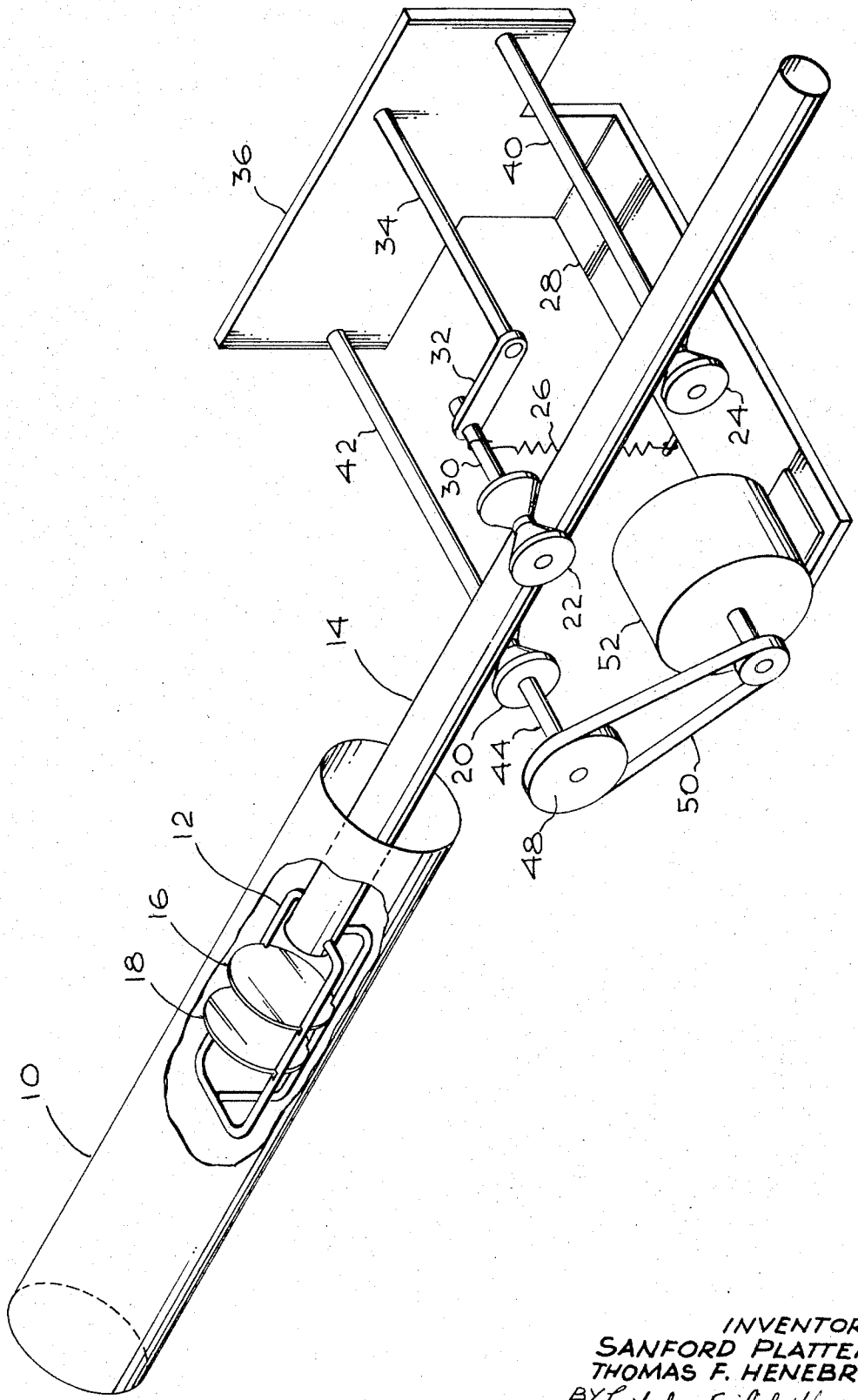

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BOAT MOVER FOR SEMICONDUCTOR FUSION PROCESS

FIELD OF THE INVENTION

This invention relates to apparatus employed with furnaces for heat treatment of semiconductor material and more particularly to improvements therein.

As part of the processing of semiconductor wafers, they are moved into a diffusion oven at a particular rate wherein they are gradually heated up to a temperature above their plastic deformation temperature, and then are moved out of the oven. The rate is usually a slow one being on the order of from 2 to 5 inches per minute. The diffusion oven usually has a central tube into which the boat filled with wafers is moved for heat processing and from which it is thereafter removed.

In many diffusion processes reaction gases produced by the heating causes the inner surface of the diffusion oven tube over which the boat is slid, to be "sticky". When a boat is moved in such a furnace, while being supported by the tube, the action of the sticky surface will cause the boat to jerk with the result that a high stress is applied to the wafers at the points where they are supported by the boat. The wafers are normally supported on edge in order to increase the through-put. Because the wafer temperature is above the plastic temperature, in most diffusion furnaces, this jerky motion results in crystal damage and unwanted electrical characteristics causing a high number of rejects or unusable circuits to occur on a chip.

OBJECTS AND SUMMARY OF THE INVENTION

An object of this invention is to provide an arrangement for moving a boat into and out of a diffusion furnace smoothly and uninterruptedly.

Yet, another object of the invention is to provide an arrangement for supporting a boat which is moved into and out of a diffusion furnace to eliminate possible damage as a result of boat motion.

These and other objects of the invention are provided by an arrangement wherein the boat is supported by a rod free and clear of the furnace walls, whereby it can be moved into and out of the tube smoothly. Thereby possible crystal damage and unwanted electrical characteristics which occur when the boat is pushed along the diffusion furnace walls are eliminated.

The novel features of the invention are set forth with particularity in the appended claims. The invention will best be understood from the following description when read in conjunction with the accompanying drawing which is a view in perspective of an embodiment of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The FIGURE shows a view of an embodiment of the invention, drawn in perspective.

A tube **10** represents the central tube of a diffusion furnace. The rest of the furnace is not shown since it is not required for an understanding of the invention. In accordance with this invention, a boat **12**, which may be seen in an opening in the tube **10**, which is made for the purpose of illustrating the boat position therein, is supported by a rod **14**. The boat **12** effectively is made of three quartz rods which are notched for the purpose of supporting exemplary spaced wafers, **16, 18**, therein. It will be appreciated that the two wafers shown are representative of a plurality of wafers which are supported in the boat. The wafers are supported on end to increase production.

The rod **14** may be also a tube, if the material of which the rod is made has sufficient stiffness. With a semiconductor diffusion process, both the boat and tube **14** are preferably made of quartz, since this is an inert material. However, in the heat treatment of other materials possibly other inert materials may be employed.

The tube **14** is supported on three guide wheels respectively **20, 22**, and **24**. These are positioned beneath and above the tube in order to support it. A spring bias is applied to the guide **22** by means of spring **26**, which is connected from the support bed to an axle **30** extending from the guide **22**. The axle is supported within a level **32**. A rod **34** supports the other end of the lever and extends to a flange **36** which is at right angles to the support bed **28**.

The guide **24** is supported by an axle **40**, which in turn also extends from the right angle flange **36**.

The guide **20** is supported on an axle **42**. The axle **42** extends and is supported in the rightangle flange **36**. A second axle **44** extends from the guide **20** to engage a pulley **48**. A pulley is rotatably driven by a belt **50**. The belt is driven by a motor **52**. The motor is supported on the support bed **28**.

The rod or tube **14** supports the boat out of contact with the furnace walls and therefore, the boat with its load of semiconductor wafers can be moved smoothly into and out of the furnace tube without causing any damage.

The roller guide **22**, which is on top of the tube, is loaded so that the tube and the boat will stay on the center line defined by the tube bottom roller guides respectively **20, 24**, throughout the entire movement. The two bottom guides can be adjusted in space so that the center line defined by them is the same as the center line of the furnace tube. The rod **14** must be of such stiffness that the deflection caused by the boat, due to its weight, when in the extended position, is negligible.

There has accordingly been described and shown herein a novel, and useful arrangement for moving a boat through a diffusion furnace in a manner so that damage to the contents thereof is avoided.

What is claimed is:

1. In a system for heat treating semiconductor material which is supported in a boat which is moved through a diffusion furnace, the improvement comprising:

means for supporting and moving said boat through said furnace free of all structures including the walls of said furnace, said means extending from within said furnace to the outside during the entire motion of said boat.

2. In a system for heat treating semiconductor material which is supported in a boat which is moved through a diffusion furnace, the improvement comprising:

a rod or tube supporting and moving said boat within said furnace free of all structures including the furnace walls throughout the entire motion of said boat, and

means for movably supporting said rod outside of said furnace.

3. Apparatus as recited in claim **2** wherein said means for rollably supporting said rod outside of said furnace

includes at least three roller guides, two of said roller guides being positioned underneath said rod and the third of said roller guides being positioned on top of said rod between the locations of said other two guides, and

means for yieldably biasing said third roller guide against said rod.

4. Apparatus as recited in claim 3 including means for rotating one of said roller guides which is beneath said rod.

5. Apparatus as recited in claim 2 wherein said boat and said rod are made of quartz.

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